Diaphragm Pump

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Introduction:

- Diaphragm is a vacuum pump. Its a positive displacement pump.

- Vacuum refers to a state where the pressure is lower than that of its surrounding atmosphere (usually ~10^5 Pa or 760 torr).

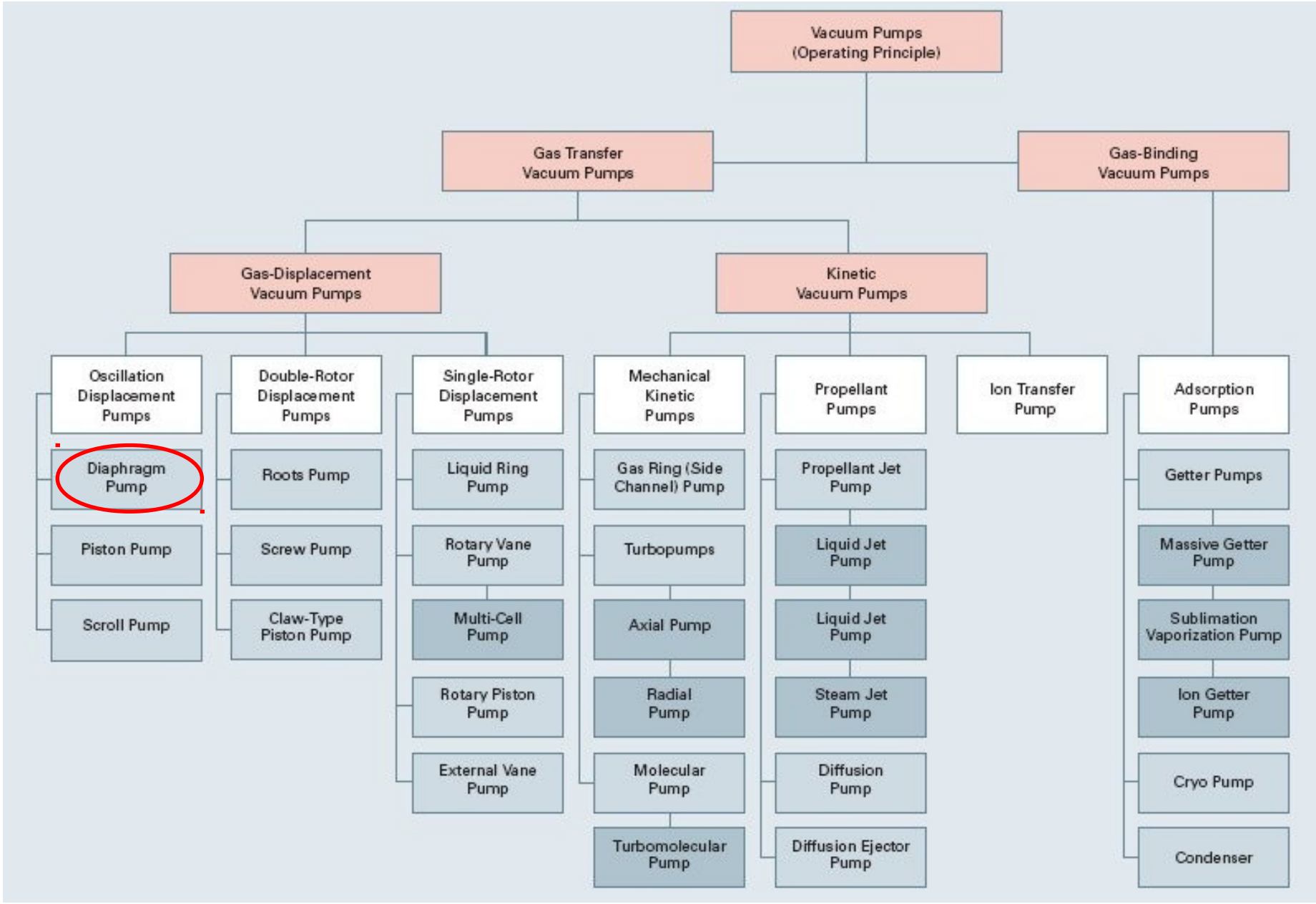
- Vacuum pump can be described as a device that removes gas molecules from an enclosure and create a certain partial pressure.

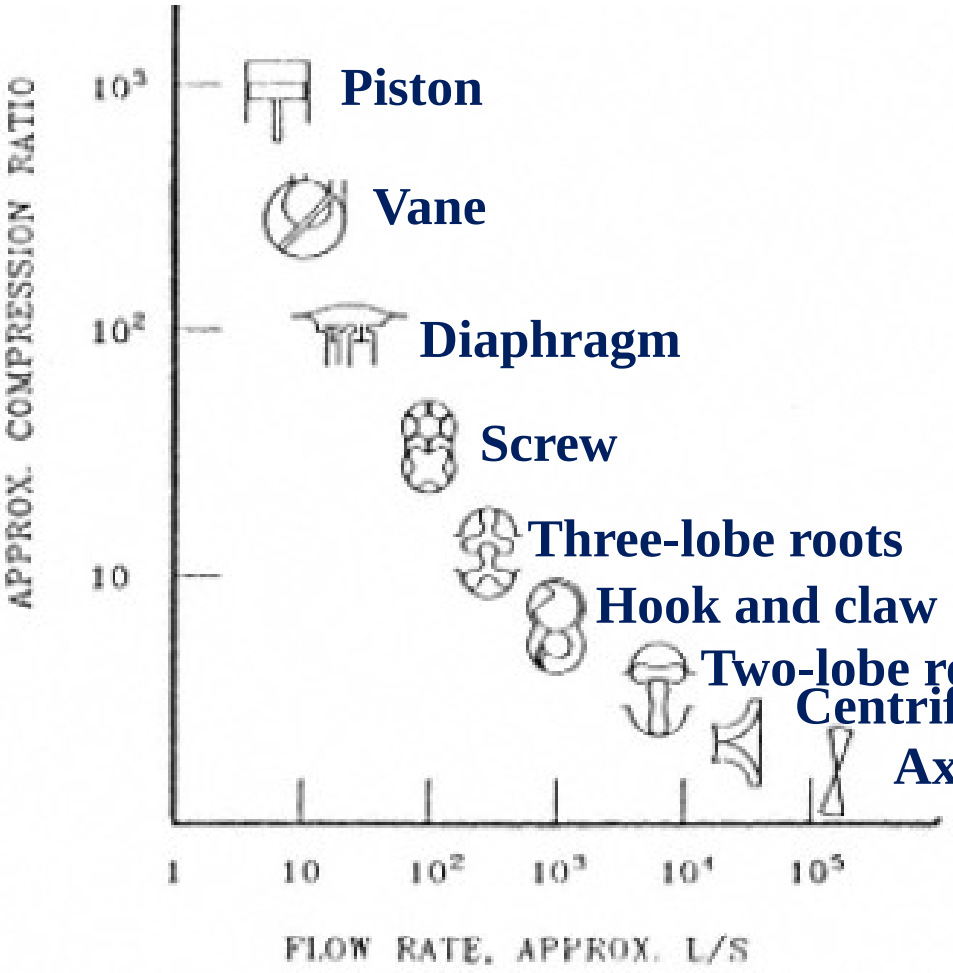
- Typical plastic or rubber sealed-piston pump can create minimum of10^3 Pa pressure. Scroll pump can create ~ 1 Pa pressure.

- Rotary vane oil pump can easily create 0.1 Pa (10^{-3} mbar) pressure. From atmosphere to this particular vacuum range called coarse vacuum.

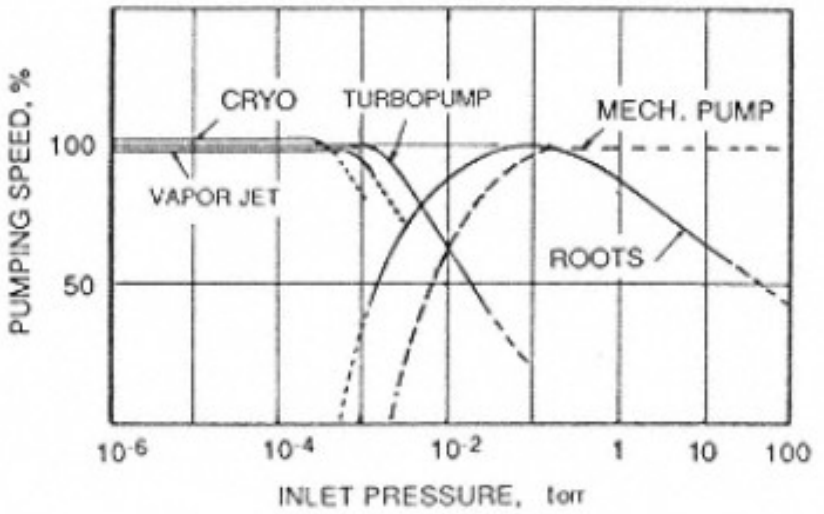
http://en.wikipedia.org/wiki/Vacuum_pump

Classification of vacuum pumps:

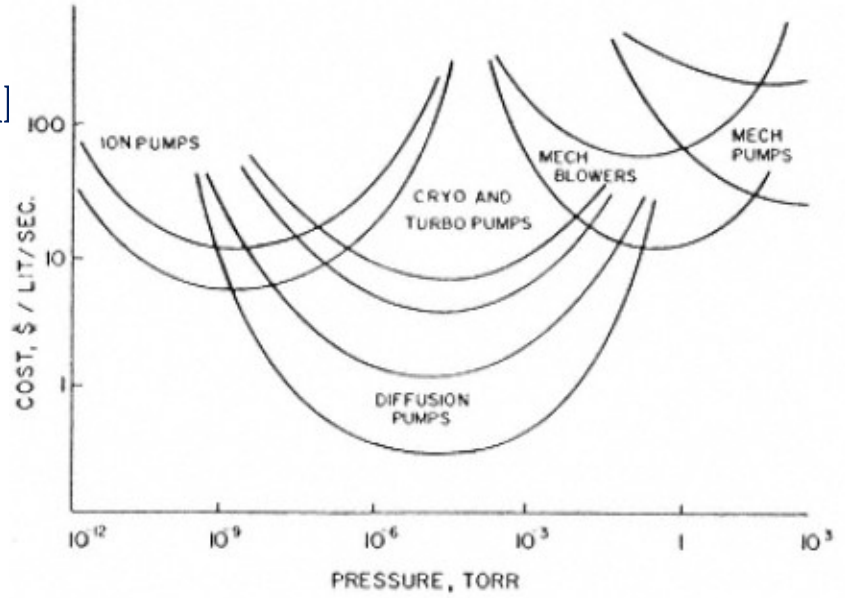




Compression ration of various pumps



Pumping speed vs. flow rate

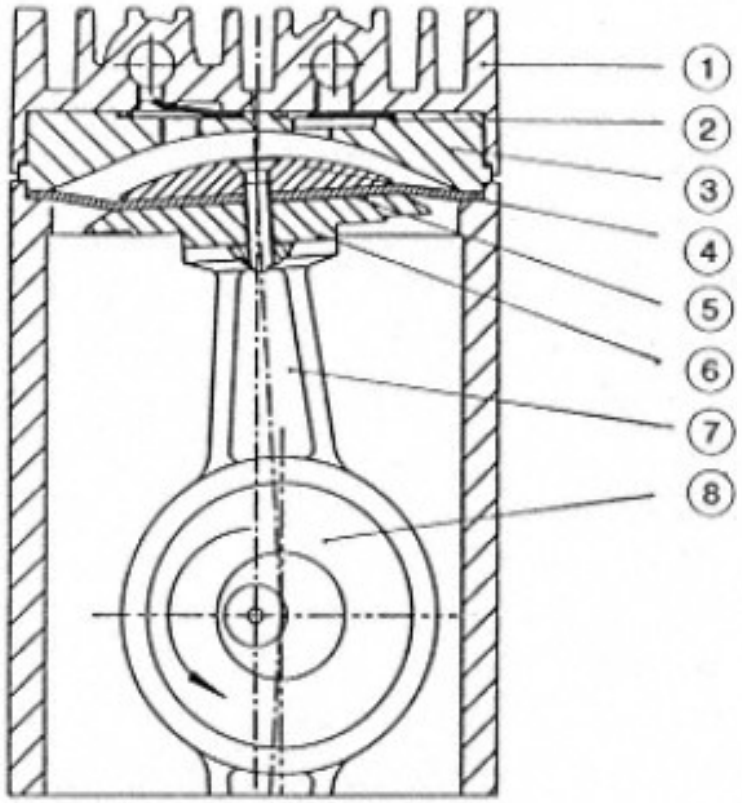


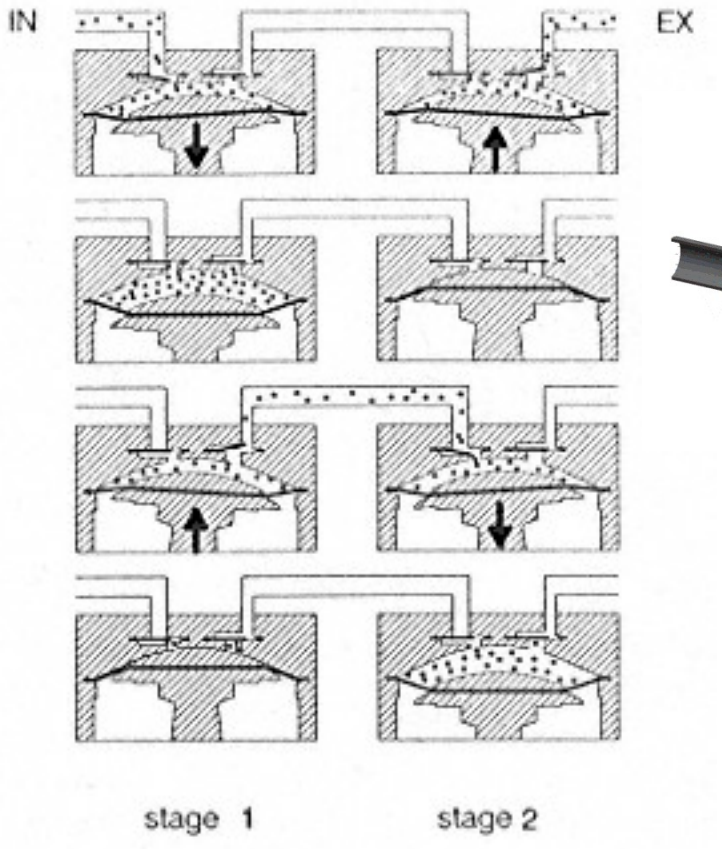
Pressure regions in which particular pumps are effective

Diaphragm price is pump ~ € 1700

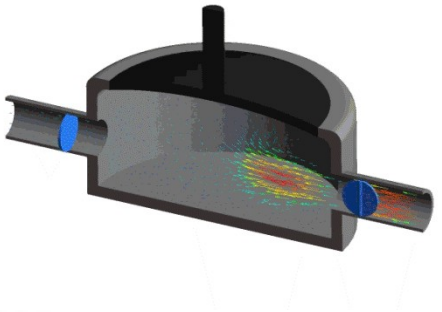
Hablanian, M. H. *High-vacuum Technology : A Practical Guide*. Mechanical Engineering, 3rd ed. CRC Press, 1997

Basic mechanism of the pump:





Progress of gas



Schematic sectional view of a diaphragm pump unit; 1) body, 2) valves, 3) cylinder head, 4) diaphragm clamping disk, 5) diaphragm, 6) diaphragm support disk, 7) connecting rod, and 8) eccentric cam

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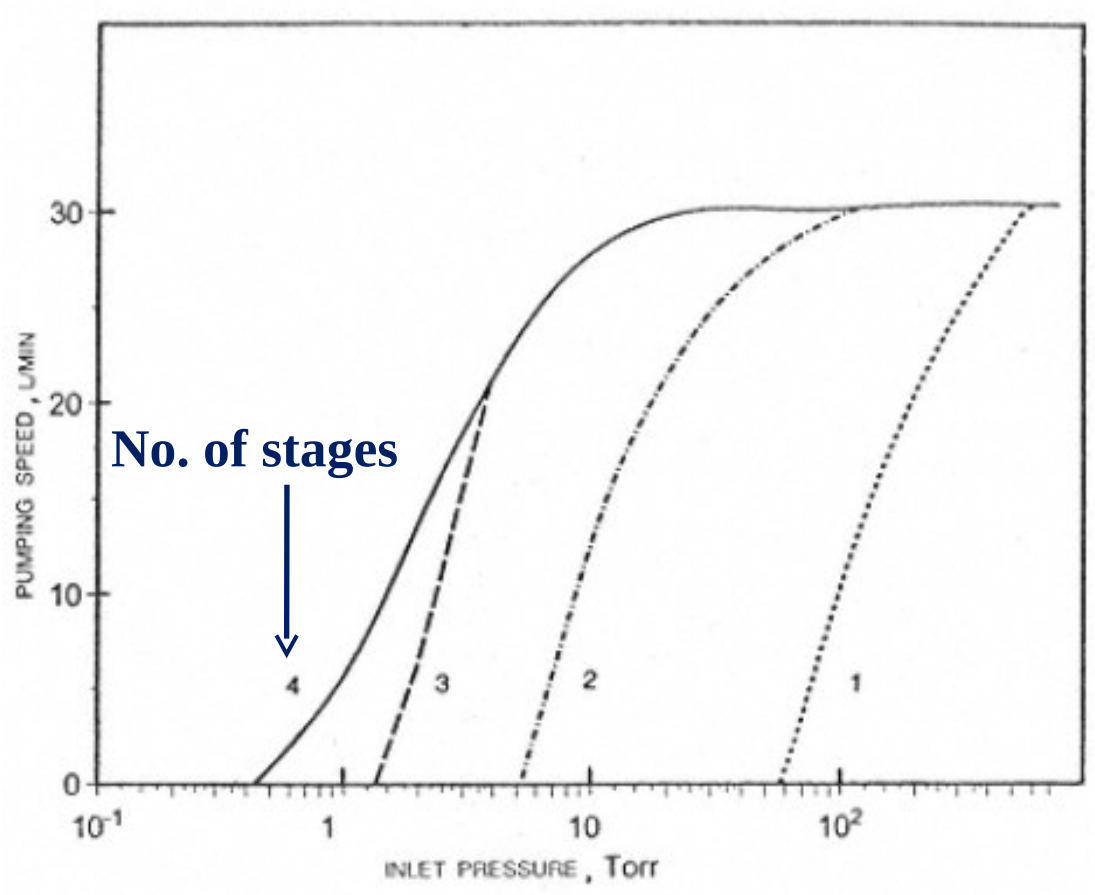
http://en.wikipedia.org/wiki/Vacuum_pump

1. The leaf (reed) valves are actuated by pumped gas pressure differences.
2. The compression is limited by the residual volume between the piston and the valve (dead space) at the end of the piston motion.
3. When the gas pressures are so low that the pressure forces are too small for actuating the valves, the pumping action ceases.



Pumping speed versus inlet pressure for a 33 L/m diaphragm pump

Advantage and limitations:

1. There is the complete separation of the driving mechanism from the pumping spaces where gas flow occurs.
2. It is a oil free pump, therefore it is clean.
3. The extent of the piston travel is limited by the flexibility and the elasticity of the diaphragm, the cycle frequency is limited by the dynamics of the leaf valves.

Thanks